5.0 Issues Evaluation

Under the Clean Water Act (2006), drinking water quality *issues* must be identified for *drinking water systems* included in the Assessment Report. In the Upper Thames River Source Protection Area (*UTRSPA*), there are groundwater municipal *drinking water systems*, shown in Map 1-3. Surface water municipal *drinking water systems* located outside of the source protection region also serve residents of the *UTRSPA*. A drinking water quality *issue* is a *parameter* (substance) or *pathogen* (disease-causing microorganism) shown to deteriorate, or trend towards a deterioration of raw (untreated) water quality. This Section of the Assessment Report describes what substances in source (untreated) water may be considered *issues* as well as the methodology used to identify *issues*. A list of drinking water quality *issues* identified in the *UTRSPA* is also provided.

5.1 What is a Drinking Water Quality Issue?

The *Technical Rules: Assessment Report* indicates which substances can be considered in the identification of drinking water quality *issues* in raw (untreated) source water. They are the Schedule 1, 2 and 3 *parameters* of the Ontario Drinking Water Quality Standards (Reg. 169/03 of the Safe Drinking Water Act, 2002) and Table 4 *parameters* of the Technical Support Document for the Ontario Drinking Water Standards, Objectives and Guidelines (an MOE publication, PIBS4449e01, June 2006). *Pathogens*, which are disease-causing organisms, can also be considered in the identification of drinking water quality *issues*.

The *Schedule 1 parameters* are the two indicator microorganisms, total coliform and *Escherichia coli (E. coli)*. These *parameters* are routinely tested in raw source and treated water, and also in distribution systems, under the Safe Drinking Water Act (2002). The testing of *Schedule 1 parameters* in raw water helps indicate possible pathogenic contamination in the raw water prior to treatment.

The *Schedule 2 parameters* are chemical substances such as lead, nitrate and atrazine. The *Schedule 3 parameters* are radio-active material such as uranium-235. The Schedule 1, 2 and 3 *parameters* have human-health based treated drinking water standards called *Maximum Acceptable Concentrations (MAC)*. The Schedule 1, 2 and 3 *parameters* and their safe levels (in treated drinking water) are listed in Tables 5-1, 5-2 and 5-3.

The *Table 4 parameters* are physical (such as taste, colour and turbidity) and chemical (such as sodium, iron and chloride) substances. Some of these affect the aesthetic quality of the water (taste, odour), and hence their treated water criteria are called *Aesthetic Objectives (AO).* Yet other Table 4 substances may interfere with the efficient and effective treatment, disinfection and distribution of the water (alkalinity, hardness), and their treated water criteria are called *Operational Guidelines (OG).* The Table 4 *parameters* and their objectives and guidelines (in treated drinking water) are listed in Table 5-4.

Pathogens are disease-causing protozoa, bacteria or viruses. Protozoa and bacteria are single-celled microscopic living organisms, while viruses are smaller than, and can live in, a single cell. *Pathogens* can cause severe or fatal waterborne illness in humans. Some are resistant to commonly used disinfectants at water treatment plants. Examples of *pathogens* include *Salmonella, Campylobacter, E. coli* strain O157:H7, *Legionella* and *Helicobacter pylori* (waterborne bacteria), noroviruses, hepatitis A and rotaviruses (intestinal viruses), and *Giardia* and *Cryptosporidium* (protozoa). In the *Technical Rules: Assessment Report*, unlike *parameters* listed in Schedule 1, 2 and 3, and Table 4, *pathogens* are not limited to a specific list. The *Schedule 1 parameters* (total coliform and *E. coli*) are routinely monitored, as described earlier, to indicate possible pathogenic contamination of raw water sources. However, specific *pathogens* are not monitored routinely in raw water sources unless there is an indication that monitoring of a specific *pathogen* is warranted.

Table 5-1: Schedule 1 Parameters (from O. Reg. 169/03 of the Safe Drinking Water Act, 2002) and their Treated Drinking Water Quality Standards

Item	Microbiological Parameter	Standard (MAC, counts/100 mL)
1.	*Escherichia coli* (E. coli)	Non detectable
2.	Total coliforms	Non detectable

Table 5-2 Schedule 2 Parameters (O. Reg. 169/03 of the Safe Drinking Water Act, 2002) and their Treated Drinking Water Quality Standards

Item	Chemical Parameter	Standard (MAC, mg/L)	Item	Chemical Parameter	Standard (MAC, mg/L)
1.	Alachlor	0.005	40.	Diuron	0.15
2.	Aldicarb	0.009	41.	Fluoride	1.5 [b]
3.	Aldrin + Dieldrin	0.0007	42.	Glyphosate	0.28
4.	Antimony	0.006	43.	Heptachlor + Heptachlor Epoxide	0.003
5.	Arsenic	0.025	44.	Lead	0.010 [c]
6.	Atrazine + N-dealkylated metabolites	0.005	45.	Lindane (Total)	0.004
7.	Azinphos-methyl	0.02	46.	Malathion	0.19
8.	Barium	1.0	47.	Mercury	0.001
9.	Bendiocarb	0.04	48.	Methoxychlor	0.9
10.	Benzene	0.005	49.	Metolachlor	0.05
11.	Benzo(a)pyrene	0.00001	50.	Metribuzin	0.08
12.	Boron	5.0	51.	Microcystin LR	0.0015
13.	Bromate	0.01	52.	Monochlorobenzene	0.08
14.	Bromoxynil	0.005	53.	Nitrate (as nitrogen)	10.0 [d]
15.	Cadmium	0.005	54.	Nitrite (as nitrogen)	1.0 [d]
16.	Carbaryl	0.09	55.	Nitrate + Nitrite (as nitrogen)	10.0 [d]
17.	Carbofuran	0.09	56.	Nitrilotriacetic Acid (NTA)	0.4
18.	Carbon Tetrachloride	0.005	57.	N-Nitrosodimethylamine (NDMA)	0.000009
19.	Chloramines	3.0	58.	Paraquat	0.01
20.	Chlordane (Total)	0.007	59.	Parathion	0.05
21.	Chlorpyrifos	0.09	60.	Pentachlorophenol	0.06
22.	Chromium	0.05	61.	Phorate	0.002
23.	Cyanazine	0.01	62.	Picloram	0.19
24.	Cyanide	0.2	63.	Polychlorinated Biphenyls (PCB)	0.003
25.	Diazinon	0.02	64.	Prometryne	0.001
26.	Dicamba	0.12	65.	Selenium	0.01
27.	1,2-Dichlorobenzene	0.2	66.	Simazine	0.01
28.	1,4-Dichlorobenzene	0.005	67.	Temephos	0.28
29.	Dichlorodiphenyltrichloroethane (DDT) + metabolites	0.03	68.	Terbufos	0.001
30.	1,2-Dichloroethane	0.005	69.	Tetrachloroethylene (perchloroethylene)	0.03
31.	1,1-Dichloroethylene (vinylidene chloride)	0.014	70.	2,3,4,6-Tetrachlorophenol	0.1
32.	Dichloromethane	0.05	71.	Triallate	0.23
33.	2,4-Dichlorophenol	0.9	72.	Trichloroethylene	0.005
34.	2,4-Dichlorophenoxy acetic acid (2,4-D)	0.1	73.	2,4,6-Trichlorophenol	0.005
35.	Diclofop-methyl	0.009	74.	2,4,5-Trichlorophenoxy acetic acid (2,4,5-T)	0.28
36.	Dimethoate	0.02	75.	Trifluralin	0.045
37.	Dinoseb	0.01	76.	Trihalomethanes (THMs)	0.100 [e]
38.	Dioxin and Furan	0.000000015 [a]	77.	Uranium	0.02
39.	Diquat	0.07	78.	Vinyl Chloride	0.002

Notes: (a) Total toxic equivalents when compared with 2,3,7,8-TCDD. **(b)** When added to drinking water, it is recommended to adjust the fluoride concentration to be 0.5 to 0.8 mg/L for optimal level of tooth decay control. Where supplies contain naturally occurring levels higher than 1.5 mg/L but less than 2.4 mg/L, the Ministry of Health and Long Term Care recommends an approach through local boards of health to raise public and professional awareness to control excessive exposure to fluoride from other sources. **(c)** This standard applies to water at the point of consumption. **(d)** Where both nitrate and nitrite exist, the total of both should not exceed 10 mg/L. **(e)** This standard is expressed as the running annual average of quarterly samples measured at point reflecting the maximum residence time in the distribution system.

Table 5-3 Schedule 3 Parameters (O. Reg. 169/03 of the Safe Drinking Water Act, 2002) and their Treated Drinking Water Quality Standards

Item	Radiological Parameter	Standard (MAC, in becquerels per litre)	Item	Radiological Parameter	Standard (MAC, in becquerels per litre)
Natural Radionuclides			Artificial Radionuclides Continued		
1.	Beryllium-7	4000.0	40.	Iron-55	300.0
2.	Bismuth -210	70.0	41.	Iron-59	40.0
3.	Lead-210	0.1	42.	Manganese-54	200.0
4.	Polonium-210	0.2	43.	Mercury-197	400.0
5.	Radium-224	2.0	44.	Mercury-203	80.0
6.	Radium-226	0.6	45.	Molybdenum-99	70.0
7.	Radium-228	0.5	46.	Neptunium-239	100.0
8.	Thorium-228	2.0	47.	Niobium-95	200.0
9.	Thorium-230	0.4	48.	Phosphorus-32	50.0
10.	Thorium-232	0.1	49.	Plutonium-238	0.3
11.	Thorium-234	20.0	50.	Plutonium-239	0.2
12.	Uranium-234	4.0	51.	Plutonium-240	0.2
13.	Uranium-235	4.0	52.	Plutonium-241	10.0
14.	Uranium-238	4.0	53.	Rhodium-105	300.0
Artificial Radionuclides			54.	Rubidium-81	3000.0
15.	Americium-241	0.2	55.	Rubidium-86	50.0
16.	Antimony-122	50.0	56.	Ruthenium-103	100.0
17.	Antimony-124	40.0	57.	Ruthenium-106	10.0
18.	Antimony-125	100.0	58.	Selenium-75	70.0
19.	Barium-140	40.0	59.	Silver-108m	70.0
20.	Bromine-82	300.0	60.	Silver-110m	50.0
21.	Calcium-45	200.0	61.	Silver-111	70.0
22.	Calcium-47	60.0	62.	Sodium-22	50.0
23.	Carbon-14	200.0	63.	Strontium-85	300.0
24.	Cerium-141	100.0	64.	Strontium-89	40.0
25.	Cerium-144	20.0	65.	Strontium-90	5.0
26.	Cesium-131	2000.0	66.	Sulphur-35	500.0
27.	Cesium-134	7.0	67.	Technetium-99	200.0
28.	Cesium-136	50.0	68.	Technetium-99m	7000.0
29.	Cesium-137	10.0	69.	Tellurium-129m	40.0
30.	Chromium-51	3000.0	70.	Tellurium-131m	40.0
31.	Cobalt-57	40.0	71.	Tellurium-132	40.0
32.	Cobalt-58	20.0	72.	Thallium-201	2000.0
33.	Cobalt-60	2.0	73.	Tritium	7000.0
34.	Gallium-67	500.0	74.	Ytterbium-169	100.0
35.	Gold-198	90.0	75.	Yttrium-90	30.0
36.	Indium-111	400.0	76.	Yttrium-91	30.0
37.	Iodine-125	10.0	77.	Zinc-65	40.0
38.	Iodine-129	1.0	78.	Zirconium-95	100.0
39.	Iodine-131	6.0			

Table 5-4 Table 4 Parameters (from the Technical Support Document for the Ontario Drinking Water Standards, Objectives and Guidelines, MOE 2006) with their Treated Drinking Water Aesthetic Objectives and Operational Guidelines

Table 4 Parameter	AO	OG
1,2-Dichlorobenzene	0.003[a] mg/L	
1,4-Dichlorobenzene	0.001[a] mg/L	
2,4-Dichlorophenol	0.0003[a] mg/L	
2,3,4,6-Tetrachlorophenol	0.001[a] mg/L	
2,4,6-Trichlorophenol	0.002[a] mg/L	
2,4,5-Trichlorophenoxy acetic acid (2,4,5-T)	0.02[a] mg/L	
Alkalinity (as $CaCO_3$)		30-500 mg/L
Aluminum		0.1 mg/L
Chloride	250 mg/L	
Colour	5 TCU	
Copper	1 mg/L	
Dissolved Organic Carbon	5 mg/L	
Ethylbenzene	0.0024 mg/L	
Hardness (as $CaCO_3$)		80-100 mg/L
Heterotrophic Plate Count (HPC)-General bacteria population expressed as colony counts on a heterotrophic plate count		f
Iron	0.3 mg/L	
Manganese	0.05 mg/L	
Methane	3L/ m^3	
Monochlorobenzene	0.03[a] mg/L	
Odour	Inoffensive	
Organic Nitrogen		0.15 mg/L
pH		6.5-8.5 (no units)
Pentachlorophenol	0.03[a] mg/L	
Sodium	b	
Sulphate	500[c] mg/L	
Sulphide	0.05 mg/L	
Taste	Inoffensive	
Temperature	15^0C	
Toluene	0.024 mg/L	
Total Dissolved Solids	500 mg/L	
Turbidity	5 NTU[d]	e
Xylenes	0.3 mg/L	
Zinc	5 mg/L	

Notes: (a) Refer to Table 5-2 (Schedule 2 parameters) for MAC standard. **(b)** The AO for sodium in drinking water is 200 mg/L. The local Medical Officer of Health should be notified when the sodium concentration exceeds 20 mg/L so that this information may be communicated to local physicians for their use with patients on sodium restricted diets. **(c)** When sulphate levels exceed 500 mg/L, water may have a laxative effect on some people. **(d)** Applicable for all waters at the point of consumption. **(e)** The OGs for filtration processes are provided as performance criteria in the Procedure for Disinfection of Drinking Water in Ontario. **(f)** Increases in HPC concentrations above baseline levels are considered undesirable.

5.2 Impact of Identifying an Issue

Should an *issue* be identified, activities that contribute to the *issue* within a *vulnerable area* are deemed to be a *significant risk* to the source of drinking water. *Significant risks* must be mitigated through the *source protection plan*.

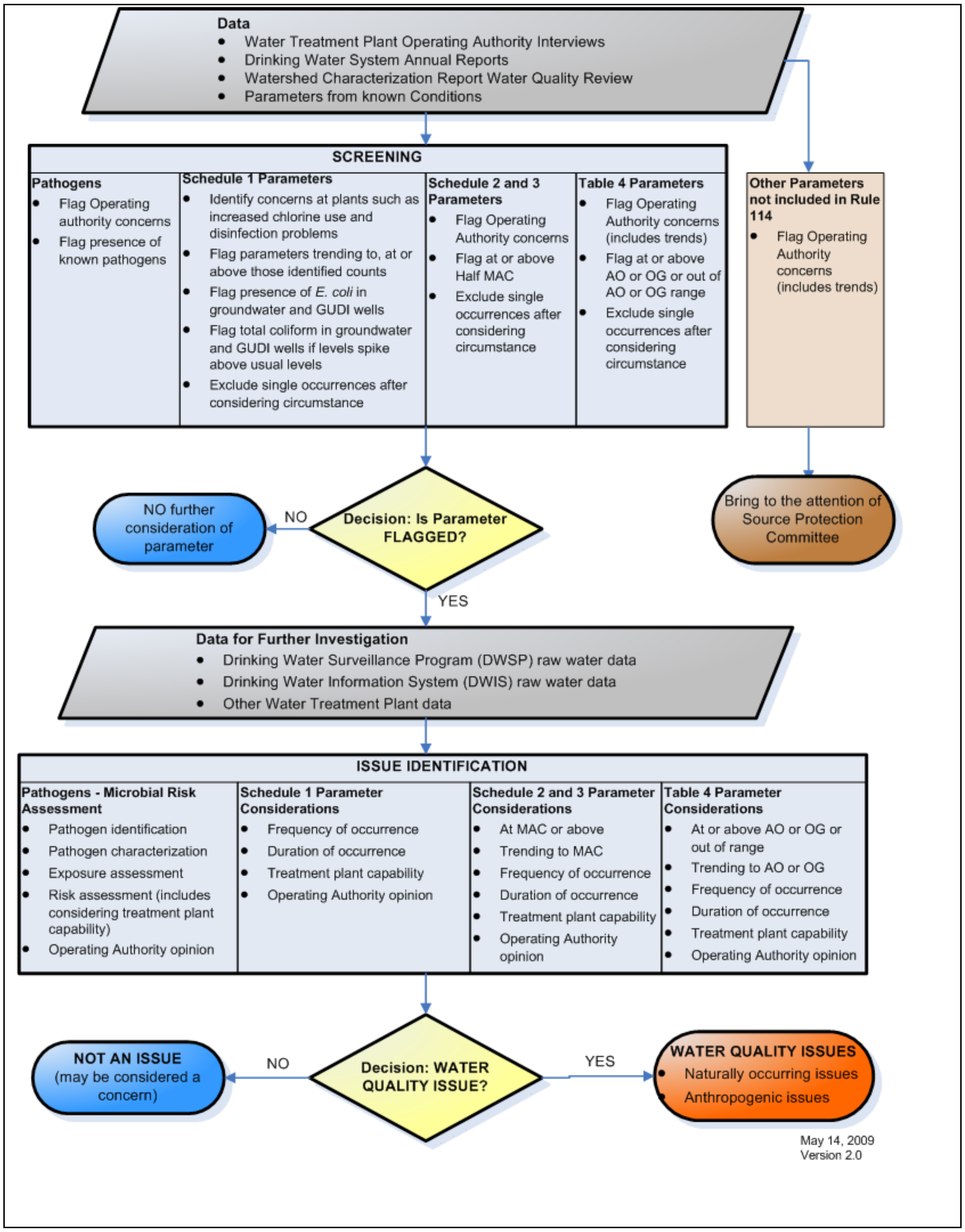
The area and the activity contributing to a drinking water quality *issue* must also be identified. Further, a third intake protection zone (*IPZ-3*) for surface water intakes may be delineated to include the activity and area known to contribute to the drinking water quality *issue*. These tasks are yet to be completed and will be part of an amended Assessment Report.

5.3 Issue Evaluation Methodology

Identifying *issues* is a key step in the overall process of protecting drinking water quality. *Issues* were identified in the Upper Thames River Source Protection Area by following the Thames-Sydenham and Region Issues Evaluation Methodology (May 14, 2009), depicted in Figure 5-1. The methodology is provided in Appendix 8. The evaluation is a two step process. Firstly, in the screening step, raw (untreated) water quality data is compared to a benchmark and *parameters* may be flagged if they meet the screening criteria. The benchmarks for chemical, physical and radioactive *parameters* are generally half the applicable human health based Ontario drinking water standards (*Maximum Acceptable Concentrations,* or *MAC*), and the full levels of the *Aesthetic Objectives (AO) and Operational Guidelines (OG)*, and any plant operating authority concerns. Secondly, in the identification step, an investigation of the *parameters* flagged through the first step is undertaken. This includes a review of trends and spikes, frequency and duration of occurrence, presence at or trending towards the applicable *MAC*, *AO* or *OG* benchmark, consideration of existing water treatment plant capabilities and discussions with the water treatment plant operating authority.

Pathogens are also evaluated in a two step process that differs from the evaluation of the Schedule 1, 2, 3 and Table 4 *parameters*. In the first step (screening), *pathogens* are flagged if they are a concern to the operating authority, known to occur in raw water, persist in treated water, or have caused a waterborne outbreak in the past. A *pathogen* that is flagged through the screening process must be subject to a microbial risk assessment to identify whether it is an *issue*. This assessment involves *pathogen* characterization, exposure assessment and risk characterization. Some of the elements considered in a microbial risk assessment are: pathological characteristics, infection mechanisms, resistance to control or treatment, survival, persistence, seasonality, reliability of treatment processes and route of human exposure.

Figure 5-1: Thames-Sydenham and Region Issues Evaluation Methodology


Data
Water Treatment Plant Operating Authority Interviews
Drinking Water System Annual Reports
Watershed Characterization Report Water Quality Review
Parameters from known Conditions
SCREENING
Pathogens
Flag Operating authority concerns
Flag presence of known pathogens
Schedule 1 Parameters
Identify concerns at plants such as increased chlorine use and disinfection problems
Flag parameters trending to, at or above those identified counts
Flag presence of E. coli in groundwater and GUDI wells
Flag total coliform in groundwater and GUDI wells if levels spike above usual levels
Exclude single occurrences after considering circumstance
Schedule 2 and 3 Parameters
Flag Operating Authority concerns
Flag at or above Half MAC
Exclude single occurrences after considering circumstance
Table 4 Parameters
Flag Operating Authority concerns (includes trends)
Flag at or above AO or OG or out of AO or OG range
Exclude single occurrences after considering circumstance
Other Parameters not included in Rule 114
Flag Operating Authority concerns (includes trends)
NO further consideration of parameter
NO
Decision: Is Parameter FLAGGED?
Bring to the attention of Source Protection Committee
YES
Data for Further Investigation
Drinking Water Surveillance Program (DWSP) raw water data
Drinking Water Information System (DWIS) raw water data
Other Water Treatment Plant data
ISSUE IDENTIFICATION
Pathogens - Microbial Risk Assessment
Pathogen identification
Pathogen characterization
Exposure assessment
Risk assessment (includes considering treatment plant capability)
Operating Authority opinion
Schedule 1 Parameter Considerations
Frequency of occurrence
Duration of occurrence
Treatment plant capability
Operating Authority opinion
Schedule 2 and 3 Parameter Considerations
At MAC or above
Trending to MAC
Frequency of occurrence
Duration of occurrence
Treatment plant capability
Operating Authority opinion
Table 4 Parameter Considerations
At or above AO or OG or out of range
Trending to AO or OG
Frequency of occurrence
Duration of occurrence
Treatment plant capability
Operating Authority opinion
NOT AN ISSUE (may be considered a concern)
NO
Decision: WATER QUALITY ISSUE?
YES
WATER QUALITY ISSUES
Naturally occurring issues
Anthropogenic issues
May 14, 2009
Version 2.0

5.4 Issues Evaluation Technical Studies

As described in Section 4 – Vulnerability Assessment, projects led by the City of London, the Upper Thames River Conservation Authority (*UTRCA*) and the County of Oxford were initiated through various partnerships, involving the *UTRCA*, the municipalities and the water treatment plant operators. Theses projects included 23 well supply systems in the Upper Thames River Source Protection Area. Similary, through these partnerships and projects, the issues evaluation work was completed, as shown in the Table 5-5 below. The consultants contracted for the issues evaluation work were Dillon Consulting and Schlumberger Water Services (formerly Waterloo Hydrologic Inc.) while the County of Oxford completed the work themselves. The City of London, Middlesex Centre, Thames Centre, County of Oxford, City of Stratford, Town of St. Marys, and member municipalities of the County of Perth East were active partners in the projects and participated in the technical steering of the projects.

The technical studies are listed below In Table 5-5.

Table 5-5 Technical Studies on Drinking Water Quality Issues Evaluation

Drinking Water Systems (Municipality)	Technical Study on Issues Evaluation
Fanshawe, Hyde Park (City of London); Birr, Melrose, Komoka (Middlesex Centre)	London, Middlesex Centre & Thames Centre Well Field Source Protection Study - Draft Source Water Issues & Concerns Assessment Report Draft Final Report October 16, 2009
Dorchester, Thorndale (Thames Centre)	London, Middlesex Centre & Thames Centre Well Field Source Protection Study - Draft Source Water Issues & Concerns Assessment Report Draft Final Report March 26, 2009
Beachville, Embro, Hickson, Ingersoll, Innerkip, Lakeside, Mount Elgin, Tavistock, Thamesford, Woodstock (County of Oxford)	Source Water Protetcion Drinking Water Systems Issues Evaluation Report. Oxford County Public Works Department. October 2009
Mitchell, Sebringville, Paul's (Perth County); St Marys (Town of St Marys); Stratford (City of Stratford)	Technical Memorandum. Issues Assessment – Perth County Municipal Drinking Water Systems. Schlumberger Water Services. March 2010
Shakespeare, Milverton (Perth East) (Note: Milverton is not in the TSR SPR, but was included in this study through a partnership with the Lake Erie SPR)	Technical Memorandum. Issues Assessment – Milverton and Shakespeare Drinking Water Systems. Schlumberger Water Services. March 31, 2010

5.5 Identified Issues

Certain *parameters* that met the screening criteria, in the first step of *issues* evaluation, were flagged. In the second step of *issues* evaluation, flagged *parameters* were further investigated to identify drinking water quality *issues* in the Upper Thames River SPA. The identified *issues* are listed and described in Table 5-6. Certain *parameters* may be due to *anthropogenic* (man-made) sources, i.e. due to the activities on land, or naturally occurring, or both. No *pathogens* are identified as *issues* in the raw (untreated) source water in the Upper Thames River SPA. It is important to note that the drinking water quality *issues* identified in Table 5-6 are based mainly on raw (untreated) water quality and do not represent the quality of water after treatment. The operation of a water treatment plant including treatment and distribution are governed separately by the Safe Drinking Water Act (2002).

The flagged *parameters* that were not identified as drinking water quality *issues* include those of aesthetic concern and naturally occurring substances. More information on flagged *parameters* is provided in Appendix 9 of the Assessment Report. The identified *issues* and flagged *parameters* will be subject to a re-evaluation in subsequent assessment reports.

Table 5-6 Drinking Water Quality Issues Identified in the Upper Thames River Source Protection Area

Muncipality/ Groundwater System	*Issue*	Brief Description of Evaluation	Natural or *Anthropogenic* Source
MIDDLESEX CENTRE			
Birr (1 well)	Hardness	Hardness levels for all the wells range between 128 to 200 mg/L (data from 2005 to 2008), and are above the treated water OG of 80 to 100 mg/L. Hardness is naturally high in the aquifer and is therefore considered a natural-based issue.	Naturally occurring
Melrose (2 wells)	Hardness	Hardness levels for all the wells range between 130 to 240 mg/L (data from 2005 to 2008), and are above the treated water OG of 80 to 100 mg/L. Hardness is naturally high in the aquifer and is therefore considered a natural-based issue.	Naturally occurring
	Turbidity	Turbidity ranged between 5.73 to 10.04 NTU (data from 2004 and 2006 to 2008). These levels are above the treated water AO of 5 NTU. This parameter should continue to be monitored, as there is no filtration incorporated in this water system, and increasing turbidity can ultimately hinder the disinfection process.	Naturally occurring
Komoka (3 wells)	None	None identified.	
CITY OF LONDON (Back up systems)			
Fanshawe (6 wells)	Hardness (all wells)	Hardness levels for all the wells range between 150 to 449 mg/L (data from 1994 to 2008 for all wells except well no. 2, for which data was from 2000 to 2008). These levels are above the treated water OG of 80 to 100 mg/L. Well 5 appears to have the highest reported hardness. Hardness is naturally high in the aquifer.	Naturally occurring
	Manganese (well no. 2 to 6)	Concentrations in wells 2, 3, 4, 5 and 6 are above the treated water AO of 0.05 mg/L atleast once between 2000 and 2008, with a high level of 0.27 mg/L in Well 3 in 2005. Concentrations in Well 4 appear to be increasing. Elevated levels are typically due to interaction between the groundwater and manganese mineral deposits.	Naturally occurring
	Turbidity (well no. 3)	In well 3, concentration (7.06 NTU) in 2007 is above the treated water AO of 5 NTU. The source would be iron or dissolved solids naturally occuring in the aquifer. This parameter should continue to be monitored, as there is no filtration incorporated in this water system, and increasing turbidity can ultimately hinder the disinfection process.	Naturally occurring
	Organic nitrogen (all wells)	Concentrations of organic nitrogen are regularly above the 0.15 mg/L treated water OG in all wells between 1994 and 2005. There is no specific trend to the data. Elevated concentrations appear to occur randomly but regularly in all wells, with a high of 1.2 mg/L in Well 3 in 2002.	Possibly both natural and *anthropogenic* causes, further investigation required
Hyde Park (1 well)	Hardness	The available data (2003 to 2008) indicates that the raw water hardness averaged 360 mg/L and was consistent throughout the data period. The average hardness level at the well exceeds the treated water OG of 80 to 100mg/L. Hardness is considered naturally high in the groundwater, and is therefore considered a natural-based issue.	Naturally occurring
	Total Dissolved	Data from 2003 to 2008 show levels of Total Dissolved Solids in the range of 486 to 591 mg/L with the average	Naturally occurring

Table 5-6 Drinking Water Quality Issues Identified in the Upper Thames River Source Protection Area

Muncipality/ Groundwater System	*Issue*	Brief Description of Evaluation	Natural or *Anthropogenic* Source
	Solids	being 545 mg/L. Although the reported levels of TDS are above the treated water AO of 500 mg/L, they are not substantially over the limit. It is likely that the high levels are a result of natural geology and are identified as a natural-based issue.	
THAMES CENTRE			
Thorndale (2 wells)	Flouride (both wells)	Flouride in the raw water has consistently been above the treated drinking water MAC of 1.5 mg/L between 2003 and 2006, and in 2008. In 2007, it was above the half MAC. Flouride concentrations are considered to be naturally high in the aquifer. A Flouride Fact Sheet, provided by the Middlesex London Health Unit (MLHU), is distributed annually to all Thorndale water system customers.	Naturally occurring
Dorchester (8 wells)	None	None identified.	
OXFORD COUNTY			
Ingersoll (7 wells)	Hydrogen Sulfide (all wells)	All wells in Ingersoll are above the treated water AO of 0.05 mg/L for Hydrogen Sulphide between 2001 and 2009. Levels are reported as ranging from 0.26 to 6.02 mg/L. It is believed that the levels in Ingersoll source water are significantly higher than some of these results indicate, as the parameter easily volatilizes in air. Complaints on Hydrogen Sulphide related odours are historically received by the Operating Authority. When not removed from the water prior to disinfection, the Hydrogen Sulphide can cause significant water quality and treatment issues (it reacts with chlorine causing a turbidity spike and potentially interrupting the disinfection process). For this reason hydrogen sulphide is being identified as an issue for the system even though it is naturally occurring and does not have a health related impact.	Naturally occurring
Thamesford (3 wells)	Nitrates (well no. 1 and 2)	The nitrate levels were above half of the treated water MAC (nitrate MAC being 10 mg/L) in Wells 1 and 2 since 1999. In 2008 the results ranged from 4.71 to 9.76 mg/L. One result of 10.2 mg/L was reported in December 2007. Nitrate is not typically a naturally occurring parameter in groundwater at levels around the MAC of 10 mg/L and may be from anthropogenic sources. The treatment process combines the high nitrate water with water from Well 3 to control nitrate levels in the distribution system. If Well 3 was to fail or be offline for long periods of time, supply could be compromised. For this reason nitrate is an issue in the Thamesford system.	Possibly both natural and *anthropogenic* causes, further investigation required
	Manganese (well no. 1 and 2)	The raw water in wells 1 and 2 have levels of manganese that are above the treated water AO of 0.05 mg/L, with concentrations of 0.14 to 0.35 mg/L (data 2001 to 2009). No increasing trend is evident. The treatment facility removes manganese through an oxidation and filtration process. Failure of this process could potentially result in decreased clarity of the water which would impact the effectiveness of the UV disinfection.	Naturally occurring

Table 5-6 Drinking Water Quality Issues Identified in the Upper Thames River Source Protection Area

Muncipality/ Groundwater System	*Issue*	Brief Description of Evaluation	Natural or *Anthropogenic* Source
Woodstock (10 wells)	Nitrates (well no. 1, 2, 3, 4, 5, 8 and 11)	Nitrate occurs in the Thornton wellfield (well no. 1, 3, 5, 8 and 11) and Tabor wellfield (well no. 2 and 4) of the Woodstock well supply. Nitrate levels in wells 1, 2, 3, 5, 8 and 11 are routinely above half of the treated water MAC (nitrate MAC is 10 mg/L). In well 4, the concentration is typically below the half MAC threshold but has occasionally been marginally above the half MAC. In 2008 the concentration ranged from 3.7 to 11.5 mg/L in the raw water. Well 3 typically has the highest Nitrate concentrations. Data for all wells is 2001 to 2009. Nitrate is not typically a naturally occurring parameter in groundwater at levels around the MAC and may be from anthropogenic sources. Nitrate concentrations at the Thornton wells (well no. 1, 3, 5, 8 and 11) have been increasing. Currently water from this wellfield is combined with water from the Taber wellfield to ensure nitrate levels in the distribution system remain low.The Thornton wellfield represents a significant portion of the total supply to the Woodstock system and therefore Nitrate has been identified as an issue in the Thornton Wellfield. Levels at the Tabor wellfield (well no. 2 and 4) are significantly lower than those seen in the Thornton wellfield and are around half of the MAC, but appear to be trending upwards. The wellfield contains two highly productive wells that are a main supply of water to the system. Increased levels of nitrate in this wellfield could reduce the effectiveness of blending the water with Thornton to lower the overall nitrate concentration in the system. Therefore Nitrate is an issue in the Tabor wellfield.	Possibly both natural and *anthropogenic* causes, further investigation required
WEST PERTH			
Mitchell (4 wells)	Flouride	Flouride levels are above the treated water AO of flouride, 1.5 mg/L. Levels ranged from 1.6 to 1.9 mg/L between 2003 and 2008.	Naturally occurring
PERTH EAST			
Shakespeare (1 well)	None	None identified.	
PERTH SOUTH			
Sebringville (1 well)	Flouride	Flouride levels are above the treated water AO of flouride, 1.5 mg/L. Levels ranged from 2.06 to 2.74 mg/L between 2003 and 2008.	Naturally occurring
	Iron	From the limited iron data, iron levels are slightly above the OG of 0.3 mg/L, at 0.35 mg/L (in 2005) and 0.4 mg/L (in 2008). An operations manager at the Ontario Clean Water Agency (OCWA), who maintains the wells, has indicated that there are no problems in treatment due to the iron levels, and will continue to monitor iron levels.	Naturally occurring
St. Pauls (1 well)	Flouride	Flouride levels are above the treated water AO of flouride, 1.5 mg/L. Levels ranged from 1.59 to 1.69 mg/L between	Naturally occurring

Table 5-6 Drinking Water Quality Issues Identified in the Upper Thames River Source Protection Area

Muncipality/ Groundwater System	*Issue*	Brief Description of Evaluation	Natural or *Anthropogenic* Source
		2003 and 2006.	
STRATFORD			
Stratford (11 wells)	Flouride	Flouride levels are at or above the treated water AO of flouride, 1.5 mg/L. Levels ranged from 1.5 to 2.6 mg/L between 2004 and 2007.	Naturally occurring
ST. MARYS			
St. Marys (3 wells)	None	None identified.	Naturally occurring

5.6 Work Plan

If a drinking water quality *issue* is identified, the area and the activity contributing to a drinking water quality *issue* must also be identified. This work has yet to be completed and will be part of an amended Assessment Report. However, a work plan to complete this work must be submitted with this Assessment Report. The Table 5-7 lays out the work plan to identify the area and the activity contributing to the *issue*. Since it is yet to be determined whether most *issues* are naturally occurring, or caused by *anthropogenic* (man-made activities), or both, it may be necessary to first determine how the *issue* is caused.

Table 5-7 : Work Plan for Identification of an Area and Activity Contributing to an Issue

System	*Issue*	Brief Description of Work	Proposed Timeline

Table 5-7 : Work Plan for Identification of an Area and Activity Contributing to an Issue

System	*Issue*	Brief Description of Work	Proposed Timeline
Fanshawe (all 6 wells)	Organic nitrogen	This *issue* is possibly due to both natural and *anthropogenic* causes. Organic nitrogen may be attributed to natural sources or by *anthropogenic* sources. In groundwater aquifers, possible sources include potential use of organic fertilizers or decaying plant matter. The owner's representative agrees that prior elevated results may have been attributed to anthropogenic activities in the wellfield, and mention that recent levels are mainly low, below the detection limit. Sampling for organic nitrogen in the well raw water and soil would need to be conducted. An investigation of the ambient groundwater quality data may help further confirm the cause of the organic nitrogen. This may require additional aquifer sampling. Organic nitrogen content in the vulnerable area soil may be compared to that of an area known to not have any anthropogenic contribution of this parameter.	Fall 2011
Woodstock (well no. 1, 2, 3, 4, 5, 8, 11) **and** **Thamesford (well no. 1 and 2)**	Nitrates	Nitrate is a naturally occurring ion that is part of the global nitrogen cycle and is ubiquitous in the environment. The main anthropogenic sources of nitrate in groundwater are the use of fertilizers, septic tanks and agricultural processes. Nitrate is not typically a naturally occurring parameter in groundwater at levels around the health related nitrate MAC of 10 mg/L and may be from anthropogenic sources. University of Waterloo has confirmed that the presence of the parameter is likely due to historical nutrient application practices on the surrounding agricultural fields. Nitrate concentrations at the wells have been increasing and the research has found that concentrations within the Wellhead Protection Area are higher than those currently seen in the production wells. (Sources of information: Bekeris, L. 2007, Haslauer, C. 2005, Padusenko, G. 2001, Robertson, W. and Sebol L. 2004). The findings of these studies will be reviewed. Additonal sampling may be needed. Sampling and analysis of nitrates in the Thamesford vulnerable area and well water may be conducted.	Fall 2011
Birr, Melrose, Fanshawe, Hyde Park	Hardness	Identified to be naturally occurring. No further action required for this *issue* according to MOE guidance.	
Melrose, Fanshawe	Turbidity	Identified to be naturally occurring. No further action required for this *issue* according to MOE guidance.	
Hyde Park	Total dissolved solids	Identified to be naturally occurring. No further action required for this *issue* according to MOE guidance.	
Fanshawe, Thamesford	Manganese	Identified to be naturally occurring. No further action required for this *issue* according to MOE guidance.	
Sebringville	Iron	Identified to be naturally occurring. No further action required for this *issue* according to MOE guidance.	

Table 5-7 : Work Plan for Identification of an Area and Activity Contributing to an Issue

System	*Issue*	Brief Description of Work	Proposed Timeline
Thorndale, Mitchell, Sebringville, St. Pauls, Stratford	Flouride	Identified to be naturally occurring. No further action required for this *issue* according to MOE guidance.	
Ingersoll	Hydrogen Sulfide	Identified to be naturally occurring. No further action required for this *issue* according to MOE guidance.	

Bekeris, L. 2007. *Field-Scale Evaluation of Enhanced Agricultural Management Practices Using a Novel Unsaturated Zone Nitrate Mass Load Approach.* Master's Thesis, University of Waterloo Earth Sciences Department.

Haslauer, C. 2005. *Hydrogeologic Analysis of a Complex Aquifer System and Impacts of Changes in Agricultural Practices on Nitrate Concentrations in a Municipal Well Field: Woodstock, Ontario.* Master's Thesis, University of Waterloo Earth Sciences Department.

Padusenko, G. 2001. *Regional Hydrogeological Evaluation of a Complex Glacial Aquifer System in a Agricultural Landscape: Implications for Nitrate Distribution.* Master's Thesis, University of Waterloo Earth Sciences Department.

Robertson, W. and Sebol L. 2004. *Age Characterization of Groundwater in the Thornton Well Field using Tritium/Helium Analyses.* University of Waterloo Earth Sciences Department.

Comment [CG1]: These will be added to the References appendix.

5.7 Data Gaps

Schedule 2 (chemical), Schedule 3 (radiological) and Table 4 (aesthetic and operational) data for the well raw water were limited due to infrequent sampling or short periods of data. Additional data collection would facilitate future *issues* evaluation.

There is usually no long-term (more than ten years) groundwater quality data available for *parameters* that can be considered *issues* under the Clean Water Act, making it difficult to determine long term trends. Continued data collection in the future would aid in determining trends and better facilitate future *issues* evaluation.

The area and activity contributing to an *issue* are yet to be identified. A work plan to accomplish this is provided in this Section, in Table 5-7. The work itself, upon completion, would be part of an amended assessment report.